VRIJE UNIVERSITEIT

Social Information Processing in Adolescents with Mild to Borderline Intellectual Disability

Executive Functions, Situational Factors, and Instrument Development

ACADEMISCH PROEFSCHRIFT

ter verkrijging van de graad Doctor aan
de Vrije Universiteit Amsterdam,
op gezag van de rector magnificus
prof.dr. V. Subramaniam,
in het openbaar te verdedigen
ten overstaan van de promotiecommissie
van de Faculteit der Gedrags- en Bewegingswetenschappen
op vrijdag 23 maart 2018 om 9.45 uur
in de aula van de universiteit,
De Boelelaan 1105

door
Maaike Marijn van Rest
geboren te Leidschendam

Seek the wisdom of the ages, but look at the world through the eyes of a child

Ron Wild

Contents

Chapter 1

General Introduction

Aggression and other externalizing behavior problems are among the most common youth mental health issues (Burke, Loeber, & Birmaher, 2002). Aggressive and antisocial behaviors are especially prominent in youth with a mild to borderline intellectual disability (MBID with IQ 50-84) which can bring them into difficult situations in everyday life (Douma, Dekker, De Ruijter, Tick, & Koot, 2007; Kaal, 2010; Schalock et al., 2010). In addition to experiencing these behavior problems, impairments in social adaptation and social maladjustment are defined as the core challenges for youth with MBID, combined with a general cognitive impairment (Schalock et al., 2010). Social information processing (SIP) is one of the factors that play a role in social adaptation and maladjustment (Dodge, 1986). In order to better understand externalizing behavioral problems of youth with MBID, it has been proposed to investigate these behaviors mainly from the perspective of social adaptation by the variation in individual SIP skills (Van Nieuwenhuijzen, 2010).

SIP theory describes in a number of steps how people cognitively process information to guide social conduct and maladjustment in social problem situations (Dodge, 1980; 1986). Crick and Dodge (1994) delineated several social-cognitive steps in a theoretical circular and transitive SIP model. According to the SIP model an individual processes a social problem situation by encoding the cues, upon which interpretations of self and others are made, subsequently, goals and responses are generated, evaluated, and selected, finally leading to a behavioral enactment. A bias in one of the SIP steps can influence the processing within the other mechanisms and result in an inappropriate behavioral outcome, which in turn can result in a new social problem situation. All steps are in constant interaction with one another via loops and with a database of previous experiences from memory, social schemas, and emotion processes (Crick & Dodge, 1994; Lemerise & Arsenio, 2000; Orobio de Castro, Slot, Bosch, Koops, & Veerman, 2003). The SIP theory has been used to understand the development of aggressive behavior in children. Empirical studies have evidenced relations between SIP steps and aggressive behavior (Dodge et al., 2015). Aggressive children tend to show more hostile SIP biases compared to their typically developing peers (Dodge & Frame, 1982; Orobio de Castro, Veerman, Koops, Bosch, & Monshouwer, 2002).

The current dissertation aimed to investigate SIP skills in a group of understudied youth, namely in adolescents with mild to borderline intellectual disability (MBID) and aggressive behavior problems, with particular attention to executive functions and situational factors associated with SIP characteristics.

Social Information Processing in Youth with MBID

Previous SIP studies have mainly focused on populations of typically developing youth and youth with externalizing behavior problems (e.g., Matthys, Cuperus, & Van Engeland, 1999). The population of youth with externalizing behavior problems, however, also includes many youth with a mild to borderline intellectual disability (MBID, Schalock et al., 2010). These youth have a full scale IQ score between 50 and 84, they show impairments in cognitive and social adaptive functioning, they more often come from high risk families, and more often experience problems in social interactions

compared to their typically developing peers (e.g., Chmelka, Trout, Mason, & Wright, 2011; Dekker & Koot, 2003; Sainero, Del Valle, López, & Bravo, 2013; Schalock et al., 2010). Youth with MBID are also at high risk for developing antisocial and delinquent behaviors and they are overrepresented in the youth criminal justice system (Douma, et al., 2007; Kaal, 2010). These youth may therefore benefit particularly from a better understanding of their problematic behaviors. In the past decades, SIP has played an important role in explaining aggressive behavior of not only typically developing youth, but youth with MBID as well (e.g., Schuiringa, Van Nieuwenhuijzen, Orobio de Castro, & Matthys, 2017; Van Nieuwenhuijzen, Orobio de Castro, Wijnroks, Vermeer, & Matthys, 2009). Compared to their typically developing peers, youth with MBID show more SIP biases and deficits, such as more hostile intent attributions and more frequent generation, positive evaluation, and selection of aggressive and passive responses (e.g., Gomez & Hazeldine, 1996; Leffert, Siperstein, & Widaman, 2010; Van Nieuwenhuijzen et al., 2011). These findings stress the importance of investigating SIP in vulnerable youth, in order to improve care for youth with MBID and to define the factors eligible for reducing behavior problems.

Social Information Processing in Adolescents

Across the literature, not only has there been limited attention to SIP in youth with MBID, but research has predominantly focused on SIP in children. SIP in adolescence remains understudied, despite the fact that aggressive behavior in adolescence can have serious consequences. In most SIP studies elementary school children, boys in particular, were included (e.g., Crick & Dodge, 1996; Dodge, Laird, Lochman, & Zelli, 2002; Kupersmidt, Stelter, & Dodge, 2011; Matthys et al., 1999; Schultz et al., 2010), with some studies focusing on children with MBID specifically (e.g., Gomez & Hazeldine, 1996; Leffert & Siperstein, 1996; Van Nieuwenhuijzen et al., 2004). Adolescence is a phase of rapid cognitive and social development, providing a second important "window of opportunity" for preventing maladaptive developmental pathways into adulthood (Crone & Dahl, 2012; Diamond, 2002). Therefore, it is important to detect the malleable factors in relation to SIP and behavior problems in adolescence. Some empirical studies showed relations between biased SIP and other cognitive or behavioral factors in adolescents specifically (Calvete & Orue, 2012; Fontaine, Burks, & Dodge, 2002; Lansford et al., 2006; Vagos, Rijo, & Santos, 2016). However, none of these studies included adolescents with MBID. Adolescents with MBID are in need of better insight into their social cognitive difficulties, especially if these cognitive difficulties can be improved in order to help them become more socially adjusted and prevent them from highly negative outcomes such as delinquent behavior. Therefore, this dissertation focused on understanding SIP and externalizing behavior in adolescents with MBID specifically.

Executive functions and Situational Factors with Social Information Processing

The relations between SIP and behavioral outcomes have been established consistently in several populations of youth. Even so, it is less well known which primary

factors precede SIP instead of follow impaired SIP. The work in this dissertation focuses on executive functions (EFs) and situational factors associated with biased or impaired SIP skills that in turn link with externalizing behaviors. The biopsychosocial model presented by Dodge and Pettit (2003) theoretically described how several innate and acquired characteristics precede mental processes, such as SIP, that link with conduct problems. For example, negative experiences in childhood may give rise to mental social schemas that in turn increase hostile attributional biases in SIP (Calvete & Orue, 2011; 2012; Van Nieuwenhuijzen et al., 2006). These social-cognitive factors add to the understanding why some youth process social information negatively, which can lead to aggressive behavior.

The work in this dissertation aims to extend this line of research on factors underlying SIP in adolescents with MBID in order to not only identify SIP characteristics, but to understand biased SIP and aggressive behavioral outcomes. Several cognitive factors, such as full scale intelligence and EFs, and situational factors, such as different types of perpetrator intent in social situations, were investigated in relation to SIP biases and deficits that link to aggressive behavior as an outcome.

Differences in SIP based on IQ have been established. Children with MBID show problems in encoding, hostile interpretations, and the selection of aggressive responses compared to their typically developing peers (e.g., Van Nieuwenhuijzen et al., 2011). In addition, first indications have been presented for relations between cognitive impulse control and SIP (Van Nieuwenhuijzen & Vriens, 2012). Nonetheless, understanding the associations between EFs and social-cognitive functions such as SIP is still a new direction in research of social-cognitive vulnerability and behavioral outcomes. Cognitive factors could create better insight into the core deficits and relevant key aspects for using SIP in treatment and intervention of aggressive and other externalizing behavior problems in adolescents (Dodge, Godwin, & Conduct Problems Prevention Research Group, 2013).

To investigate relations between EFs and social-cognitive functions, Chapter 3 of this dissertation presents a first step in understanding SIP in adolescents with severe externalizing behavior problems, among which adolescents with MBID, by examining the EFs associated with biases and impairments in SIP. EFs are higher-order cognitive functions that are theorized to regulate cognitive functions (Miyake & Friedman, 2012; Séguin & Zelazo, 2005), among which SIP. Therefore, the three EFs focused attention, inhibition, and working memory were investigated as cognitive functions associated with the SIP steps from the SIP model by Crick and Dodge (1994). By studying the associations between several EFs and specific steps from the SIP model, this study aimed to provide clues how higher-order cognitive functions may affect SIP.

Chapter 6 of this dissertation provides the further investigation of the relations between EFs and SIP for adolescents with MBID specifically. This study used a mediation model to understand how EFs may be indirectly associated with aggressive behavior through several SIP steps. Congruent with Chapter 3, the EFs focused attention, behavioral inhibition, and working memory were tested, but with multiple new neurocognitive tests to construct latent variables in order to provide stronger EF constructs than in the study from Chapter 3 where single variables were used for the measurement of EFs. For the inclusion of aggressive behavior, a latent variable was also included. Introducing this novel mediation model and a more specific focus on adolescents with MBID, Chapter 6 aims to add to the understanding of biased SIP and aggressive behavior problems from the perspective of impaired EFs.

In addition to investigating the purely cognitive EFs factors underlying SIP skills, this dissertation also examined situational factors that bring out SIP biases in youth. The study in Chapter 5 tested how different situations varying in perpetrator intent could influence the output of SIP. Following the seminal studies by Dodge (1980; Dodge, Murphy, & Buchsbaum, 1984), SIP studies throughout the literature focused merely on SIP measured in ambiguous situations. It is, however, expected that also accidental situations with a negative outcome provide relevant insight into SIP biases of youth with MBID. Considering the general cognitive impairments in youth with MBID (Schalock et al., 2010), accidental situations may be difficult to process for these youth as these situations create a large cognitive load due to the incongruence of negative and positive cues. These specific accidental situations could therefore be also relevant in the understanding of SIP deviances and behavioral maladjustment of youth with MBID. Behavior as a general concept is situation-dependent (e.g., Magnusson, 1976); even so, this situation-specificity of cognitive and behavioral functions is understudied and unacknowledged in the literature and especially important for understanding social behavior in relation to other individuals.

Therefore, the study in Chapter 5 aimed to provide insight into the sources of deviant social behavior among youth with MBID, by examining the situation-specific social-cognitive processes that precede social maladjustment. Different real life problem situation types, namely hostile, ambiguous, and accidental situations, were hypothesized to relate to SIP variations. These variations were also related to differences in IQ, namely compared between adolescents with MID, borderline IQ, and average IQ, and to differences in behavior, between adolescents with and without externalizing behavior problems. By including the relevance of several situation types the outcomes of this study may help understand SIP styles of vulnerable youth in various real life situations.

Social Information Processing Assessment

The scientific aim of this dissertation to understand EFs and situational factors related to SIP skills and externalizing behavior problems in adolescents with MBID, merged with the interest from the clinical field in having a practical and valid assessment tool for individual SIP skills, appropriate for youth with MBID. The proposed research aim therefore required the development of a diagnostic instrument for assessment of SIP skills in adolescents with MBID. Previous studies have presented several SIP measures that were used in research (Denham, Way, Kalb, Warren-Khot, & Bassett, 2013; Dodge & Price, 1994; Kupersmidt et al., 2011; Matthys, et al., 1999; Schultz et al., 2010; Van Nieuwenhuijzen, Bijman, et al., 2009; Van Nieuwenhuijzen & Vriens, 2011; Ziv & Sorongon, 2011). These instruments, however, were mainly focused on SIP in

elementary school children, only few on SIP in adolescents (Vagos, Rijo, & Santos, 2016) and mostly in the typically developing population or youth with externalizing behavior problems. No instrument was suitable for the measurement of SIP in adolescents with MBID. The work in this dissertation thus focused on developing a new valid assessment procedure for SIP, with a final aim to develop a diagnostic version of a SIP instrument to measure individual SIP profiles in adolescents. A digital instrument was developed, in line with the study by Kupersmidt et al. (2011), in order to adhere to modern computer-based interactions, to improve practical usability for clinical professionals, and most importantly, to enhance the validity of the psychological assessment by increasing motivation in the youth to participate.

Chapter 2 in this dissertation presents the first development of an assessment procedure for SIP in adolescents with severe externalizing behavior problems in secure residential care, among which adolescents with MBID. The development of this measure included an interview study for examining themes for social problem situations that were used in videos to measure SIP skills. The construct, content, and criterion validity of this new SIP measure were explored in order to conclude upon the valid use of the measure in subsequent analyses. It was also examined whether the measure differentiated between adolescents with MBID and with average intelligence level, whom are both represented in the population of vulnerable youth within secure residential care.

As a next step, Chapter 4 describes the development of an improved digital diagnostic instrument for social information processing, called SIVT. In this chapter, interview and pilot studies are presented that were used to alter the SIP assessment from Chapter 2 and to develop a diagnostic SIP instrument for children and adolescents with MBID and with externalizing behavior problems. The interview study corresponded with the interviews in adolescents described in Chapter 2, which were designed for developing themes for social problem situations used in videos to measure SIP skills. Compared to previous measures, it was aimed to improve the SIP instrument in order to be more relevant for individual diagnostic research. The digital SIVT was therefore developed including three real life situation types varying in perpetrator intent, namely hostile, ambiguous, and accidental. These situation types may add to the ecological validity of the instrument and to the clinical knowledge about individual SIP biases across several real life situations that can form a problem for individuals with MBID and with externalizing behavior problems. The pilot in Chapter 4 aimed to explore the validity of the new digital diagnostic SIVT, in order to be able to use the SIVT in further analyses. First indications of ecological, face, content, and criterion validity of the SIVT were explored for child and adolescent samples separately. This chapter aims to provide a next step in developing a relevant diagnostic instrument that can help clinical professionals estimate the individual SIP biases and impairments in youth with MBID and with externalizing behavior problems. As these biases may create vulnerability for these youth in developing social maladjustment and aggression toward others, the understanding of strengths and weaknesses in specific SIP steps across specific situations may add to improving the care for youth with MBID and externalizing behavior problems.

Dissertation Outline

The current dissertation was based on four different study samples that were recruited in sequence, which resulted in five papers presented in the chapters of this dissertation. First, adolescents in secure residential care facilities and the Youth Criminal Justice System were recruited for exploring a SIP assessment procedure. Second, an interview study was performed in children with MBID as part of the development of a new diagnostic SIP instrument. Third, pilot studies were used to test the new instrument in children and adolescents. Finally, a main study was performed in children and adolescents with and without MBID, and with and without externalizing behavior problems to investigate EFs and situational factors related to SIP and aggressive behavior. Table 1 shows the overview of the four studies with accompanying samples and the main focus on research themes that are presented in the chapters of this dissertation. All chapters in this dissertation share a focus on social information processing, the factor of externalizing behavior problems, and the factor of intelligence or specifically incorporating adolescents with MBID. Figure 1 presents the conceptual overview of the factors and relations investigated in the studies of this dissertation. The previously established relations between SIP and externalizing behavior as an outcome are supported by this model, and the factors that may precede impaired SIP are added to be investigated in adolescents with MBID and with externalizing behavior problems.

To summarize, the overall aim of this dissertation was to investigate SIP and the executive functions and situational factors related to SIP skills in adolescents with MBID and with externalizing behavior problems, by means of new valid assessment procedures for measuring individual SIP skills.

Table 1. *Overview of Main Focus and Study Samples used in Each Chapter*

Study samples	Main focus		
	Instrument Development	Situational Specificity	Executive Functioning
Secure Residential Care Study in adolescents with MBID and average intelligence (*n* = 94)	Chapter 2		Chapter 3
Interview Study in children with MBID (*n* = 14)	Chapter 4		
Pilot Study in children and adolescents with MBID and average intelligence (*n* = 109)	Chapter 4		
Main Study in children and adolescents with MBID and average intelligence (*n* = 437)		Chapter 5	Chapter 6

Note. Six to 12-year-old children were included in the Interview and Pilot Study samples for the development of the SIP instrument, see Chapter 4. Children were also included in the Main Study sample for the collection of norm data for the instrument. The children, however, did not fall within the scope of this dissertation on SIP in adolescents, and were therefore not included in Chapters 5 and 6 using Main Study data.
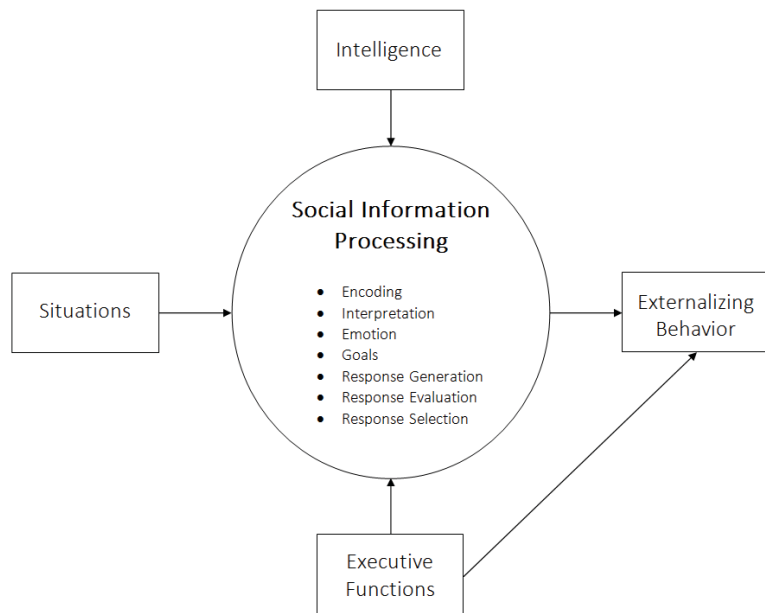
Figure 1. Conceptual Overview of the Factors and Relations Investigated in this Dissertation.

Chapter 2 presents a new assessment procedure for SIP in adolescents with severe externalizing behavior problems in secure residential care, among which adolescents with MBID. Development of themes for social problem situations as a basis for videos in the new instrument are presented, as well as the exploration of validity of the instrument.

Chapter 3 studies the associations between EFs and SIP skills in adolescents with severe externalizing behavior problems in secure residential care, among which adolescents with MBID. Hypothesized associations between focused attention, inhibition, and working memory with several SIP skills could provide the first indications of how EFs can affect biased and impaired SIP.

Chapter 4 describes the development of the SIVT, a new digital diagnostic instrument for the measurement of SIP in children and adolescents with MBID and with externalizing behavior problems. Two studies are incorporated to develop the SIVT, namely an interview study to develop themes for social problem situations as a basis for videos of the SIVT, and a pilot to explore the validity of the new SIVT for child and adolescent versions.

Chapter 5 investigates the situational specificity of SIP in adolescents with MID, borderline IQ, and average IQ, and in adolescents with or without externalizing

behavior problems. Situations varying in perpetrator intent being hostile, ambiguous, or accidental, are expected to relate to several SIP skill differences according to variations in IQ and behavioral level. This chapter aims to understand how different situations affect SIP in various groups of vulnerable youth.

Chapter 6 studies a mediation model of the relations between the EFs focused attention, behavioral inhibition, and working memory with aggression via SIP skills in adolescents with MBID. This chapter aims to understand the relations from impaired executive functions to SIP and subsequently toward aggressive behavior.

Finally, Chapter 7 summarizes the findings of the studies, integrates the conclusions, discusses the outcomes, and provides clinical and theoretical implications and future research recommendations.

Chapter **2**

Developing a new assessment procedure of social information processing in adolescents within secure residential care

Abstract

The purpose of the present study was to develop a new assessment procedure of social information processing (SIP) for adolescents, to explore its validity and to examine whether it differentiated between IQ groups. Ninety-four adolescents within secure residential care were administered the SIP instrument, the Youth Self Report and two subtests of the WISC/WAIS. Results showed that the constructs underlying the items of the instrument were associated with profiles from the SIP theory, the subsequent SIP steps were correlated, and several SIP steps were correlated to self-reported behavior. No differences were found between IQ groups. These first results have implications for adjustment of the instrument. Further research should confirm construct validity and psychometric qualities of the scales.

Introduction

Adolescents in secure residential care show deviances from social-emotional and behavioral perspectives (Jansen, Schüller, Oud, & Arends, 1995; Knorth, Harder, Zandberg, & Kendrick, 2008). In secure residential care, these adolescents are provided with treatment in order to improve their social behavior. A recent Cochrane meta-analysis showed that cognitive behavioral therapy for antisocial behavior in residential settings is significantly better than standard treatment at 12 months follow-up (Armelius & Andreassen, 2007). However, the reduction in recidivism was found to be only about 10%, the effect size was small (d = .25), and there was no evidence of long-term effects. Therefore, new and more thorough insights into the characteristics of these youth and the factors underlying their behavior are needed to adjust therapies and increase treatment outcomes.

An important ingredient of cognitive behavioral therapy is the training of social problem solving skills, which are part of social information processing (SIP) (Crick & Dodge, 1994; Dodge & Pettit, 2003). According to the SIP theory, several cognitive steps are performed in social situations. First, social information is encoded, and others' intentions are interpreted. Then, goals are identified and several responses to the problem situation are generated. Finally, in the decision making process, responses are evaluated by considering self-efficacy and consequences, and one response is selected. These subsequent steps in the SIP model are associated with one another, and disturbances in these processes lead to problematic functioning in daily life (Crick & Dodge, 1994).

In order to adjust treatment and therapies to the individual characteristics, there is a need to assess SIP and problem solving skills. In the tradition of research on the SIP theory these skills are assessed by posing questions about hypothetical problematic situations such as being provoked, or more generally, being disadvantaged (e.g., Matthys, Maassen, Cuperus, & Van Engeland, 2001; Van der Helm et al., 2013). The problematic social situations are typically vocally described; either presented via audiocassettes, videorecorded vignettes, or presented using pictures of social problems. These procedures provided information on the social information processing and social problem solving skills of children through the identification with their own behavior in the social context with peers. Various tests to assess SIP in elementary school children have been developed (e.g., Kupersmidt, Stelter, & Dodge, 2011; Matthys, Cuperus & Van Engeland, 1999; Van Nieuwenhuijzen, Vriens, Scheepmaker, Smit, & Porton, 2011), but SIP instruments for adolescents are still lacking. We therefore set out to develop such a test instrument for adolescents with antisocial behavior.

An important and evermore increasing group within adolescents with antisocial behavior is the youth with mild to borderline intellectual disabilities (MBID; IQ between 50 and 84). Several studies have indicated that youth with MBID show high rates of aggressive behavior problems (Dekker, Koot, Van der Ende, & Verhulst, 2002), are more likely to show antisocial and delinquent behavior than their typically developing

peers (Douma, Dekker, De Ruijter, Tick, & Koot, 2007), and are overrepresented in the criminal justice system (Kaal, 2010). Moreover, it was found that youth with both MBID and behavioral problems often live in multi-problem families (Dekker & Koot, 2003). Therefore, these youth are considered as particularly vulnerable. When developing an instrument to assess SIP in adolescents with antisocial behavior this group needs special attention.

The development of a SIP test instrument for adolescents could be based on research of SIP deviances in elementary school children with externalizing behaviors (Dodge, McClaskey, & Feldman, 1985; Matthys, Cuperus, & Van Engeland, 1999) and in children who also had MBID (Leffert & Siperstein, 1996; Van Nieuwenhuijzen, Orobio de Castro, Van der Valk, Wijnroks, Vermeer, & Matthys, 2006; Van Nieuwenhuijzen, Orobio de Castro, Wijnroks, Vermeer, & Matthys, 2009). It was shown that externalizing behaviors of children with an average IQ were associated with encoding fewer social cues, generating fewer responses, higher confidence in the ability to enact an aggressive response, and selecting an aggressive response (Matthys, Cuperus, & Van Engeland, 1999). Externalizing behaviors of children with MBID were associated with encoding negative cues, hostile intent attribution, aggressive response generation, and negative evaluation of assertive responses (Van Nieuwenhuijzen et al., 2009; 2011). These children were also found to differ from their typically developing peers in SIP by encoding more negative information, generating fewer assertive solutions to social problems, and generating more submissive and aggressive solutions than the control group with an average intelligence level (Van Nieuwenhuijzen, Orobio de Castro, Wijnroks, Vermeer, & Matthys, 2004; Van Nieuwenhuijzen et al., 2011). Anew, attention must be addressed to this specific group of youth with antisocial behavior problems.

Here we report the first steps in the development of a SIP test instrument for adolescents with antisocial behavior - with and without MBID - in secure residential care. Since the participants of the current study differed from those in previous studies regarding age (Matthys et al., 1999; Van Nieuwenhuijzen et al., 2009; 2011), first, new material was developed including hypothetical situations typical for adolescent themes in daily life. Second, several validity estimates of the new instrument were examined, such as construct validity, content validity, and criterion validity. Third, we investigated whether the newly developed SIP instrument differentiated between IQ groups in adolescents in secure residential youth care.

Method

Participants

In the present study 94 respondents in the age of 12 to 20 years old (*M* = 15.88, SD = 1.44, Male = 43) participated. All participants were living in Dutch secure residential care: in juvenile justice institutions, or in secure youth care institutes. Beforehand, an exclusion criterion of the study was a diagnosis of an Autism Spectrum Disorder (ASD),

Table 1. *Descriptive statistics of adolescents within secure residential care*

	MBID (*n* = 42)		AIQ (*n* = 52)			
	M	SD	M	SD	t	p
IQ	75.62	5.85	95.19	7.84	13.43	.00
Age	16.12	1.50	15.69	1.37	-1.44	.15
Aggression (*T*-score)	56.76	9.15	55.75	6.12	-.44[a]	.66
Rule Breaking (*T*-scores)	63.00	9.56	63.44	8.08	.41[a]	.69
Gender (% male)	45.20		46.20		.01[b]	.93
Ethnicity (% minority)	64.30		40.40		5.31[b]	.02

[a] t and *p* values based on raw scores
[b] Chi square

as individuals with MBID and ASD show different SIP patterns than those without ASD (Embregts & Van Nieuwenhuijzen, 2009). In addition, eight participants were excluded due to incomplete test batteries, or incomplete IQ data. For the group comparison, participants were divided into groups based on their IQ: either MBID with an IQ between 55-84 (*n* = 42), or average IQ (AIQ) with an IQ of 85 and above (*n* = 52). Table 1 presents the descriptives of the participants in the present study, and IQ-group differences on behavioral measures. The adolescents with MBID did not differ from adolescents with an AIQ on gender, age, and antisocial behaviors. A significant difference was found for ethnicity: the group of adolescents with MBID contained more respondents from an ethnic minority, than the group with an AIQ (Table 1).

Measures

Externalizing behavior problems. For the assessment of externalizing behaviors, adolescents completed the 32 items of the syndrome scales "Aggression" and "Rule breaking behavior" of the Dutch version of the Youth Self Report (YSR; Verhulst, Van der Ende, & Koot, 1997; Achenbach, 1991), which has been shown to be a valid and reliable self-report instrument in youth with MBID (Douma, Dekker, Verhulst, & Koot, 2006). Each item described certain externalizing behavior, on which the adolescents had to answer on a 3-point scale: 1) not true, 2) sometimes/somewhat true, or 3) often/totally true. In nine cases some item scores were missing.

These missing values (with a maximum of three) were replaced by the individual's average score for the corresponding syndrome scale, in order to be able to calculate total scores for Aggression and Rule breaking behavior. By means of the Dutch norms for YSR, average syndrome scores and *T*-scores were obtained for the two syndrome scales. The standard YSR calculation describes that *T*-scores higher than 69 are in the clinical range (98th percentile), and *T*-scores between 65 and 69 are in the borderline range (93th percentile).

Cognitive functioning. A full-scale IQ score (FIQ) was used from the respondent's clinical file in case an intelligence test (WISC or WAIS) was administered in the year

previous to our test administration. In case there was no recent FIQ, an estimation of global intelligence was obtained using the subtests "Vocabulary" and "Block Design" from the Dutch version of the WISC-III^NL in case participants were under 17 years of age (Kort et al., 2005) and the WAIS-III (Uterwijk, 2000) in case participants were 17 years or older. Estimates of the full scale IQ were made on basis of the sum of the scaled scores on subtests "Vocabulary" and "Block Design" (Silverstein, 1970a), as these subtests strongly correlate to the full scale score of WISC and WAIS (Silverstein, 1970b). This estimation has been successfully used in youth with MBID as well (e.g., Van Nieuwenhuijzen et al., 2011).

Social information processing. This section provides a description of the methods and performed procedures, as a first step in the development of a new SIP measurement for adolescents in secure residential care.

Description of instrument development. The development of the instrument was based on the Social Problem-solving Test (SPT), which was developed for elementary school children (Cuperus, 1997; Matthys, Cuperus, & Van Engeland, 1999; Van Nieuwenhuijzen et al., 2005; 2009). In the SPT, the various SIP steps were assessed using six video fragments of hypothetical problem situations and a structured interview. The video fragments of the SPT were based on a taxonomy of problematic social situations for school children (Matthys, Maassen, Cuperus, & Van Engeland, 2001). As adolescents are concerned with different developmental tasks, they were expected to experience problems in different situations than children. Therefore, in order to identify problematic social situations for adolescents we interviewed adolescents with and without MBID and their care staff in secure residential care institutes.

The main topic of the interview was: "What situations including others can make you angry?" Individual interviews were transcribed and processed according to a scheme with the components: antecedent, behavior and consequence. For each respondent, the described fragments were classified and scored as types of social situations. Then, the situations were ordered, and themes or subthemes were scored independently by two researchers, who reached consensus on the content of proposed (sub)themes. For all respondents, frequencies of each theme and subtheme were calculated, which resulted in two types of situations: 1) Dealing with authority, and 2) Dealing with peers, and three main topics: 1) Receiving respect from others, 2) Injustice, and 3) Accepting rules or hierarchy. For each topic a social situation was selected from the interviews according to the following criteria: 1) situations were perceived as a problem both by youth with and without MBID and externalizing problems, 2) situations were in relation to either teachers, parents or peers, 3) situations were either simple or complex in number of individuals involved, and 4) two gender specific situations were selected, as some situations were only mentioned by females. Themes and situations were chosen by the research team and subsequently discussed with care staff and psychologists working in the field. Based on these situations, film scripts and corresponding visual shots were written together with a Master's student director from the Dutch Film and Television Academy (AHK). Video fragments were played by ten adolescent and four adult actors with diverse ethnicities, and recorded and edited by the student director. The project resulted in eight professionally recorded fragments, i.e., four gender-neutral fragments, and four gender-specific fragments. Descriptions of fragments are provided in Appendix A.

Description of measures. After each video fragment, a structured 24-item interview assessed SIP skills of the participants. Previous to each video fragment, the adolescents were asked to imagine that they were the victim in the specific situation: it was clarified which person in the video they had to identify with. The SPT-MID, a test for social achievements in children with MID developed by Van Nieuwenhuijzen et al. (2009; 2005), and an application for social information processing developed by Kupersmidt et al. (2011) provided both theoretical and practical perspectives for the development of new questions in the interview of the SIP instrument. In the following section all SIP steps and associated test variables are described.

Encoding was measured with the question: "What happened in this video fragment?" For each video fragment the ten most essential elements of the situation were independently determined by three research assistants, who reached consensus about the relevancy of the elements. For each element mentioned by the respondent one point was rewarded, leading to a range of scores from 0- 10. A total mean score was calculated across all six video fragments.

In order to assess *problem identification*, the question "What do you think is the problem in this video fragment?" was asked. This question required the integration of information from the steps Encoding and Interpretation. Responses were coded as: incorrect (0 points), semi-correct (1 point), or correct (2 points), and total mean scores were calculated across all six video fragments.

Interpretation was assessed by asking the participants: "X happened. Did Y (the perpetrator) do it on purpose?", "Do you think that Y meant to be mean?", "Would you feel rejected by Y?", and "Would you feel respected by Y?" The participants answered on a five-point Likert type scale, ranging from 1 (totally disagree) to 5 (totally agree). Total mean scores were obtained by calculating means across all six video fragments.

Response generation was measured with the question: "If you would be the victim, what would you do?" Answers were divided into three categories, along with the quality of each response: 1) assertive/prosocial, 2) aggressive/antisocial, and 3) submissive/passive. Three total scores for spontaneous assertive, aggressive and submissive responses were calculated by counting the number of assertive, aggressive, and submissive responses respectively across the six video fragments. The scores could range from 0 (= this response was not given) to 6 (= this response was always given).

After the first spontaneous answer of the participant, respondents were asked to think of other ways of responding to the given situation. These additional responses were coded and a *response repertoire* score was calculated by counting the amount of different responses for each video fragment. These scores ranged from 0 (= no response), to 3 (= three different response categories mentioned). A total mean response repertoire score was calculated using the scores of all six video fragments.

The identification of Goals was measured with the questions: "Why would you enact like you just mentioned?", "Is that to prevent a fight?", "Is that to show who is the boss?", "Is that to take revenge?", "Is that to maintain a good relationship", and "Is that to receive respect?" The participant could answer on a 5-point Likert type scale, ranging from 1 (totally disagree) to 5 (totally agree). Total mean scores were calculated across all six video fragments.

Evaluation was measured through coding the participant's answers on three presented responses on the screen- assertive, aggressive, and submissive responses- as possible enactments by the victim in the video fragments. Three questions were asked after the presentation of each response in order to assess the participant's response evaluation. For example, after the presentation of an assertive response, the participants were asked: "Would it be easy for you to enact like the victim?" (*self-efficacy*), "Would it turn out well if you would enact like the victim?" (*consequence*), and "Do you think it is good to enact like the victim?" (*positive evaluation*). Once more, the participant could answer on a 5-point Likert type scale, ranging from 1 (totally disagree) to 5 (totally agree). Total mean scores were calculated across all six video fragments.

Response selection was assessed by again presenting the three videorecorded responses, subsequently asking the participant: "Which of the three responses would you choose as the best reaction?" Total scores for assertive, aggressive and submissive response selections were calculated by counting the number of responses respectively across the six video fragments. Each variable had a minimum score of 0 (= this response was never chosen) and a maximum of 6 (= this response was always chosen).

For the exploration of the face validity of the instrument, SIP measurements of 29 adolescents in the age of 13 to 18 were examined. These adolescents were all treated in either a juvenile justice institution, or a secure youth care institute in the Netherlands, and they were different from the adolescents that participated in the interviews of our study. The participants acknowledged that the films and questions from the test instrument SIVT were realistic and representative: the participants could recognize themselves in these situations.

Procedure

For the current study approval was attained from the ethical committee of the Faculty Psychology and Education at the Vrije Universiteit Amsterdam. Adolescents were recruited through cooperation of several secure residential care institutes: juvenile justice institutions and secure youth care institutes. Information on the study was presented for management and staff members of the secure residential care institutes. When institutes cooperated, youth in the age of 12 to 20 were informed and asked to participate. After written informed consent was given, the assessment was planned. The adolescents were not selected on their (aggressive and antisocial) behavior, but on their placement in a secure residential setting. Furthermore, for anonymity reasons, no data were collected about the delinquent events or crimes of the adolescents. Trained test assistants administered the SIP test on location of the institutions. After assessment, youth were given a small monetary incentive for their cooperation to the research.

Results

Overview of the Analyses

First, to study construct validity an Exploratory Factor Analysis (EFA) was performed in order to examine the underlying dimensions of the SIP instrument. Second, in order to study the content validity correlations were computed between successive SIP steps from the theory by Crick and Dodge (1994): Encoding, Interpretation, Identification of Goals, Response Generation, Response Evaluation, and Response Selection. Third, in order to study criterion validity correlations were computed between SIP skills and aggressive and rule-breaking behavior as reported by the participants. Fourth, in order to examine differences in SIP between groups with or without MBID MANCOVA's were performed. Ethnicity was included as covariate in the analyses. An alpha level of .05 (two-tailed) was considered statistically significant.

Construct validity

The EFA provided a seven-factor structure in the items of the SIP instrument. Analyzing both the amount of variance explained and the scree plot of the components, resulted in seven factors (R^2 = 64.17). These seven factors were named after content: 1) Encoding, 2) Hostile intent attribution, 3) Submissive interpretation, goal identification and response generation, 4) Identification of dominant goals, 5) Assertive goal identification, and response generation, 6) Aggressive goal identification, and inadequate response generation and decision making, 7) Assertive decision making (Table 2). Response repertoire was the single variable that did not relate to any construct in the SIP test instrument (all factor loadings < .30).

Content validity

The content validity was explored through correlations between successive SIP steps (see Appendix B). Significant correlations were found between relevant consecutive SIP steps from the SIP model. Encoding information in the social situation was moderately correlated with the problem identification of the situation. Subsequently, problem recognition was associated with the interpretation of the perpetrator acting "on purpose". However, it was not associated with other types of interpretation. Several types of interpretation - except for the interpretation "on purpose" - were moderately correlated with several goals of behavior, and with spontaneous generation of several responses. For example, the interpretation "mean" was associated with the goal "to take revenge", and with the generation of an aggressive response. Thereafter, three goals of behavior were significantly correlated to the spontaneous generation of the three responses. For example, "to take revenge" correlated positively with the generation of an aggressive response. However, this did not account for the goals "show them who is the boss" and "to receive respect". Between the generation of responses and the evaluation of those responses several significant positive associations were found, mainly for aggressive responses; for example with self-efficacy and with consequence. A trend

Table 2. *Exploratory Factor Analysis*

Factors	1	2	3	4	5	6	7
SIP variable							
1. Encoding	.49						
2. Problem recognition	.42						
3. Interpretation On purpose		.60					
4. Interpretation Being mean			.46				
5. Interpretation Rejection	-.43						
6. Interpretation Respect		-.44					
7. Goal Prevent fight			.44				
8. Goal Show who is the boss				.54			
9. Goal Revenge						-.47	
10. Goal Keep good relationship					.58		
11. Goal Receive Respect				.65			
12. Generate Assertive Prosocial					.66		
13. Generate Aggressive Antisocial						-.49	
14. Generate Submissive Passive			.44				
15. Response repertoire							
16. Self-efficacy Assertive							.52
17. Self-efficacy Aggressive						-.32	
18. Self-efficacy Submissive						.62	
19. Consequence Assertive							.67
20. Consequence Aggressive						-.57	
21. Consequence Submissive						.59	
22. Positive evaluation Assertive							.62
23. Positive evaluation Aggressive						-.62	
24. Positive evaluation Submissive						.57	
25. Selection Assertive							.60
26. Selection Aggressive						-.85	
27. Selection Submissive						.43	

was found for the association with positive evaluation of aggression. Concerning the final steps of the SIP model it was found that positive evaluation of responses associated rather highly and positively with response selection of that same type of response, but negatively with the selection of other types of responses. Furthermore, some indications for multicollinearity were found in the SIP variables measuring "Evaluation": the items measuring positive evaluation of the three response options – assertive, aggressive, and submissive – associated highly with the items measuring consequences of the three response options respectively.

Criterion validity

Third, in order to study criterion validity correlations between SIP variables and self-reported aggressive and rule-breaking behavior were computed. Aggressive behavior was related to the interpretation "mean", goal "preventing a fight", and self-efficacy and consequence of an aggressive response (see Table 3). Youth who reported aggressive behavior tend to have hostile intent attributions, do not have the goal "to prevent a fight", feel confident in enacting and have positive expectations of the outcome of an aggressive solution. Rule-breaking behavior was related to interpretation "mean", aggressive response generation, self-efficacy submissive, positive evaluation of an aggressive response, and selection of an aggressive and submissive response (see Table 3). Youth who reported rule breaking behavior tend to have hostile intent attributions, generate aggressive solutions, do not feel confident in enacting a submissive response, evaluate aggressive responses positively, and select aggressive but not submissive responses.

Group differences

To investigate whether the newly developed SIP instrument differentiated between IQ groups multivariate tests were conducted. Results showed that SIP skills did not significantly differ between groups of adolescents with MBID and an average intelligence within secure residential care (Pillai's Trace = .98, p = .51). When analyzing the univariate test statistics a difference was found on "problem recognition" between the two IQ groups (F(1, 92) = 6.40, p = .01). The adolescents with MBID performed worse on problem recognition (M = 1.01, SD = .44), compared to the group with an average intelligence (M = 1.25, SD = .46).

Table 3. *Correlations between SIP variables and YSR behavior*

Content of SIP variable	Aggressive behavior	Rule breaking behavior
Encoding	.00	-.01
Problem recognition	.03	.12
Interpretation On purpose	-.06	.01
Interpretation Being mean	.21*	.24*
Interpretation Rejection	.04	.16
Interpretation Respect	-.02	-.06
Goal Prevent fight	-.22*	-.12
Goal Show who is the boss	.16	.19
Goal Revenge	.06	.08
Goal Keep good relationship	-.15	-.08
Goal Respect	.01	-.02
Generate Assertive Prosocial	-.13	-.12
Generate Aggressive Antisocial	.19	.27**
Generate Submissive Passive	-.07	-.16
Response repertoire	-.05	-.02
Self-efficacy Assertive	.00	-.15
Self-efficacy Aggressive	.21*	.12
Self-efficacy Submissive	-.10	-.28**
Consequence Assertive	-.09	-.18
Consequence Aggressive	.24*	.15
Consequence Submissive	-.06	-.20
Positive evaluation Assertive	-.03	-.12
Positive evaluation Aggressive	.01	.27**
Positive evaluation Submissive	.10	-.18
Selection Assertive	-.07	.02
Selection Aggressive	.11	.21*
Selection Submissive	-.04	-.27**

* $p < .05$; ** $p < .01$

Discussion

Cognitive behavioral therapy for antisocial behavior in residential settings, for both people with and without MBID, seems promising (Armelius & Andreassen, 2007; Willner et al., 2013). An important ingredient of cognitive behavioral therapy is the training of social problem solving skills, which are part of SIP. To improve treatment outcome, more thorough insights into SIP of these adolescents is needed. However, measures to assess SIP in adolescents are lacking. Here we report the first steps in developing such a test instrument. New videorecorded vignettes were developed including hypothetical situations typical for adolescent themes in daily life. The exploration of the validity of the SIP measure for adolescents provided several promising results: the constructs underlying the items of the instrument were associated with SIP profiles from the SIP theory, the subsequent SIP steps were correlated, and several SIP steps were correlated to self-reported behavior. These validity results should be considered as a first exploration of this new SIP instrument due to small sample size in combination with the lack of a control group outside secure residential care.

The results also have implications for adjustment of the instrument. With regard to construct validity, results showed constructs representing SIP steps, such as hostile intent attribution, identification of dominant goals, and assertive decision-making. Other constructs, however, were a combination of SIP steps. Encoding variables were associated with Interpretation "rejection", which was expected to correlate to the interpretation variables, as was the case in the study by Kupersmidt et al. (2011). This item (Would you feel rejected?) probably refers more to reflections of emotions, rather than to hostile intent attribution. In adjusting the instrument this item should be considered. In addition, several constructs contained variables that reflected more than one SIP step. However, although relations existed between variables from different SIP steps, they all referred to the same response (e.g., evaluation, self-efficacy and selection of a submissive response). Considering the seven constructs did relate to different stages and profiles of social information processing, we may conclude that the associations between scores on several variables provide support for the theoretical model underlying this new assessment procedure to measure SIP.

Concerning content validity subsequent steps of SIP were found to correlate moderately to highly, as described in the theory by Crick and Dodge (1994). However, not all steps correlated as expected. One possible explanation is the formulation of the questions in relation to some of the videorecorded vignettes. In several adult related vignettes, the question to measure hostile intent attribution (Did the mother remind her daughter of the agreements they just made on purpose?) had a low face validity, which may have led to random and vague answers by respondents. In addition, some high associations have been found between the items measuring positive evaluation and the items measuring consequences of the three response options. These high correlations could be an indication of multicollinearity, since the two variables "positive evaluation" and "consequences" of the response options were measured with similar questions. The

repetition of similar questions could be demotivating or misleading for the respondents. This issue should be addressed in the adjustment of the instrument.

Criterion validity was explored by examining correlations between SIP variables and self reported behavioral measures, since the extent to which youth exhibit adaptive or problematic (social) behaviors is thought to depend on their social information processing skills (Dodge & Pettit, 2003). Results showed adolescents who scored high on aggressive and rule breaking behavior to have more aggressive and less submissive problem solving skills, although not all SIP variables were associated with behavior. In the present study a relation was found between hostile intent attribution and aggressive and rule-breaking behavior, which has been established in ample studies examining typically developing children and youth (see meta-analysis by Orobio de Castro, Veerman, Koops, Bosch, & Monshouwer, 2002). However, studies on children with MBID have shown inconsistent results on the relation between hostile intent attribution and behavior (Leffert & Siperstein, 1996; Van Nieuwenhuijzen et al., 2009; 2011). Variations in SIP measurement instruments may influence the results on hostile intent attribution and behavior (Orobio de Castro et al., 2002). SIP, indeed, has been measured using several materials: videos, pictures, or audio/verbal stories; the latter providing the opportunity for the creation of own fantasies, more than the former two. Video fragments entail the risk that respondents are not sufficiently emotionally involved in the situation. In the current study, when developing new videorecorded vignettes this was taken into account. In addition, the relation between SIP variables and behavior may also depend on age. In the meta-analysis by Orobio de Castro et al. (2002) the correlational effect size in children (8-12 years old) was larger than the effect size in adolescents (rs = .22 and rs = .12 respectively). However, in a group of youth with more problematic behavior (comparable to our current adolescent sample) the difference in effect sizes between children and adolescents was less apparent (rs = .22 and rs = .15 respectively). With regard to the relation between other SIP steps and behavior, such as Generation or Evaluation of responses, to our knowledge no age related differences have been studied systematically.

Furthermore, we investigated whether the newly developed SIP instrument differentiated between IQ groups in adolescents in secure residential youth care. The groups with MBID and AIQ within secure residential youth care did not differ from one another in aggressive or rule breaking behavior, nor in social information processing skills. These results are in contrast with earlier studies that show differences in behavior problems (Dekker et al., 2002) and social information processing (Van Nieuwenhuijzen et al., 2004, 2011) between groups with different intelligence levels. One explanation for the absence of significant differences between IQ groups on behavior and SIP could lie in the homogeneity of the group of adolescents within secure residential youth care. The adolescents that are placed in these institutions have all serious behavior problems and have often committed serious offenses and are therefore separated from home, their families, and society.

The novelty of the present study is the development of a SIP instrument for adolescents. An important, but undervalued, aspect of developing such an instrument is selecting the appropriate stimulus material. The problem situations of the vignettes in the present study are based on theory, research in children, and interviews with adolescents. Although results of the study are promising, they should be interpreted with some limitations of our study in mind. First, we did not recruit respondents utterly according to the definition of MBID: an IQ of 50- 70, or an IQ of 70- 84 in conjunction with problems in social adaptive functioning, since no standardized data about the latter were available. Second, a limitation concerning the criterion validity is that common method variance may have been a source of measurement error. Both data on SIP skills and behavior measures were acquired from the adolescents within secure residential youth care, whereas these data should be acquired in two different report groups (one by proxy). Third, we were unable to draw strong conclusions on differences between intelligence levels due to small sample size in combination with the lack of a control group outside secure residential care.

With the development of this new instrument, the current study presented an assessment procedure that may be useful in the diagnostic field of youth with or without MBID in secure residential care. However, since we have only explored the validity of the new instrument, we have found merely indications for a promising basis as a diagnostic instrument to measure SIP. Results of the present study have provided feedback for further development of the instrument, such as adjustment of items. Further research with larger samples is needed in order to confirm construct validity and to further examine the psychometric characteristics, such as reliability, of the instrument. In addition, the proposed relations between SIP steps, and between SIP and behavior should be examined in adolescents within secure residential care, as well as in adolescents in other settings, both with and without MBID. Research could pinpoint the important phases and situations in which treatment on both SIP and behavior is required in these groups of youth, in order to prevent them from living a life with social and behavioral problems. Moreover, more attention should be paid on SIP from early childhood until late adolescence, providing age influences that can be incorporated in diagnostic research and effective interventions.

Appendix A

Video fragments of the new SIP assessment

Situation	Theme	Fragment	Description
Dealing with authority	Accepting rules	Going out	A mother tells her daughter that she can't go out tonight, if she also wants to go to a party the next evening. A moment later, the girl still tries to sneak out, and mother reprimands her.
	Injustice	Noise	Students are laughing and making noise with a mobile in a classroom. One boy is not joining them, but tries to pay attention to class. Just as the teacher turns around, the mobile is placed at the boy's desk, and the teacher punishes him.
	Respect	Question (female)	A class about the topic "sexuality" is coming to an end, and a girl wants to ask the teacher some more intimate questions. Then she crosses a line and asks the teacher: "When was your first time?" The teacher is first surprised and then reprimands the girl.
	Respect	Soccer (male)	A boy and a teacher are talking about a soccer match. Being enthusiastic, the boy imitates an offense by pushing the teacher. He responds by reprimanding the boy.
Dealing with peers	Hierarchy	Weekend (male)	A group of adolescents is laughing together. One boy is not included in the group, but tries to join them by laughing. A girl looks at him and then pushes him hard while shouting: "What are you laughing at?!"
	Hierarchy	Nail polish (female)	A group of girls is chatting and polishing nails. While one girl is trying to polish the nails of another girl, she is bossed around and the other girl says: "It's just like she's my pet!"
	Injustice	Telephone	Students are sitting in a classroom when the teacher leaves for a cup of coffee. One girl takes the mobile of the teacher and throws it back on the table as the teacher returns. He asks the students: "Who did this?" And the guilty girl blames another student.
	Respect	Fat	Two boys are watching a film on a mobile, they talk and laugh about it. One boy cannot see the film and asks what is funny; he is ignored. Suddenly, he gets angry and calls the mother of another boy "fat".

Appendix B

Correlations between SIP steps

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	-																									
2	.29**	-																								
3	.19	.24*	-																							
4	.01	.20	.11	-																						
5	-.08	-.10	-.16	.10	-																					
6	.21*	.10	-.19	-.35**	-.00	-																				
7	.09	-.01	-.03	-.06	.10	.13	-																			
8	-.18	.02	-.02	.21*	.14	-.08	-.10	-																		
9	-.18	-.10	-.12	.29**	.15	-.28**	-.18	.45***	-																	
10	.21*	.03	.08	-.12	.11	.29**	.59***	.09	-.15	-																
11	-.03	-.05	-.12	.05	.21*	.01	.17	.42***	.29**	.44***	-															
12	.26*	.13	.05	-.20*	.01	.21*	.23*	.05	-.09	.31**	.20	-														
13	-.09	.02	-.02	.31*	.05	-.19	-.32*	.11	.35***	-.32*	-.04	-.69***	-													
14	-.22*	-.17	-.07	-.13	-.06	-.03	.11	-.18	-.28**	-.01	-.20	-.45***	-.33***	-												
15	.10	.03	.26*	-.25*	.09	-.07	-.22*	.02	-.05	-.04	-.08	-.08	.10	.00	-											
16	.07	.13	.15	.01	.07	.15	.21*	-.02	-.06	.17	.03	.17	-.15	-.04	.06	-										
17	.02	.02	.10	.01	-.05	-.07	-.42***	.01	.15	-.31*	-.14	-.26*	.36***	-.08	.16	.07	-									
18	-.09	-.09	.04	-.10	-.10	.00	.22*	-.15	-.17	.19	-.01	.10	-.33***	.26*	-.02	.34***	-.20	-								
19	.03	.04	.18	.10	.12	-.01	.07	.07	.03	.05	-.01	.20	-.10	-.14	.02	.60***	-.01	.17	-							
20	.05	.05	-.18	.24*	.04	-.10	-.13	.21*	.31**	-.21*	-.03	-.09	.21*	.11	-.09	-.13	.28**	.49***	-.09	-						
21	-.07	-.17	.11	.02	.03	.03	.09	-.16	-.11	.01	.03	-.12	.03	-.12	.07	.19	-.04	.11	.36***	-.34***	-					
22	-.01	-.00	.17	.04	.03	.03	.03	.03	-.10	.07	-.04	.11	-.05	-.08	-.06	.59***	.18	.71***	-.06	-.30*	.37***	-				
23	.01	.13	-.06	.26*	-.02	-.13	-.03	.35***	.32**	-.07	.16	-.01	.18	-.18	-.05	-.12	.16	-.09	.41***	.56***	-.09	-.02	-			
24	.00	-.13	-.03	.07	-.01	.06	.11	-.14	-.08	-.03	-.02	-.06	-.03	.12	-.05	.26*	-.07	.54***	.50***	-.13	.82***	.42***	-.23*	-		
25	.08	.18	.08	-.13	.19	.14	.09	-.00	-.12	.19	-.01	.14	-.08	-.09	.10	.46***	.06	-.06	-.06	.25*	.10	.37***	-.25*	-.01	-	
26	-.05	.04	-.03	.23*	-.15	-.22*	-.24*	.22*	.29**	-.29**	.04	-.24*	.31**	-.07	-.07	-.51***	.21*	-.39***	-.51***	.46***	-.45***	-.47***	.55***	-.40***	-.67***	-
27	-.06	-.27**	-.06	-.10	-.09	.06	.16	-.25*	-.16	.08	-.04	.09	-.25*	.20	-.05	-.02	-.31**	.52***	-.07	-.19	.39**	.05	-.31**	.46.***	-.54***	-.26**

Note. Numbers in the first column and first row refer to variables as displayed in Table 2. $* p < .05; ** p < .01; *** p < .001$

Chapter 3

Executive functions and social information processing in adolescents with severe behavior problems

Abstract

One tradition in research for explaining aggression and antisocial behavior has focused on social information processing (SIP). Aggression and antisocial behavior have also been studied from the perspective of executive functions (EFs), the higher-order cognitive abilities that affect other cognitive processes, such as social cognitive processes. The main goal of the present study is to provide insight into the relation between EFs and SIP in adolescents with severe behavior problems. Because of the hierarchical relation between EFs and SIP, we examined EFs as predictors of SIP. We hypothesized that, first, focused attention predicts encoding and interpretation, second, inhibition predicts interpretation, response generation, evaluation, and selection, and third, working memory predicts response generation and selection.

The participants consisted of 94 12- to 20-year-old respondents living in residential facilities, all showing behavior problems in the clinical range according to care staff. EFs were assessed using subtests from the Amsterdam Neuropsychological Test battery. Focused attention was measured by the Flanker task, inhibition by the Go/No-go task, and working memory by the Visual Spatial Sequencing task. SIP was measured by video vignettes and a structured interview.

The results indicate that positive evaluation of aggressive responses is predicted by impaired inhibition and selection of aggressive responses by a combination of impaired focused attention and inhibition. It is concluded that different components of EFs as higher-order cognitive abilities affect SIP.

Introduction

Aggression and antisocial behavior are two of the most common mental health problems in youth (Burke, Loeber, & Birmaher, 2002). One tradition in research for explaining aggression and antisocial behavior has focused on social information processing (SIP; Crick & Dodge, 1994). According to SIP theory, social behavior depends on several social cognitive processes. First, social information is encoded, and others' intentions are interpreted. Then, goals are identified and several responses to the problem situation are generated. Finally, in the decision-making process, responses are evaluated by considering self-efficacy and consequences, and a response is selected. Ample research has shown that these social information processes play an important role in the development of aggressive behavior in youth with average intelligence (for reviews, see Crick & Dodge, 1994; Matthys & Lochman, 2005) and in youth with lower cognitive functioning (Healy & Masterpasqua, 1992; Leffert & Siperstein, 1996; Van Nieuwenhuijzen et al., 2006; Van Nieuwenhuijzen, Orobio de Castro, Wijnroks, Vermeer, & Matthys, 2009). Especially hostile interpretation, aggressive response generation, positive evaluation and selection of aggressive responses are related to aggressive behavior.

Aggression and antisocial behavior have also been studied from the perspective of executive functions (EFs) or cognitive control. EFs are the higher-order cognitive abilities that develop from late infancy through adulthood (Séguin & Zelazo, 2005; Weyandt, 2005). EFs include several functions such as planning, working memory, inhibition, and flexibility (Nigg, 2006). According to Miyake et al. (2000) the EFs construct consists of interrelated, but distinct components: inhibition, working memory, and set shifting. Individual studies and meta-analyses have demonstrated associations between impaired performance of EFs and aggressive behavior from early childhood to adulthood, both in the general population and in clinical samples (e.g., Goldstein, Hahn, Hasher, Wiprzycka, & Zelazo, 2007; Lewis et al., 2008; Morgan & Lilienfield, 2000; Oosterlaan, Logan, & Sergeant, 1998; Schoemaker, Mulder, Dekovic, & Matthys, 2012).

Research has merely focused on EFs in relation to behavior and symptoms, and little attention has been given to the influence of EFs on cognitive processes in general. Conceptually, EFs as higher-order cognitive abilities affect other cognitive processes, such as social cognitive processes. Here, we argue that intact inhibitory control, including attention control or focused attention (Diamond, 2006), and intact working memory are necessary for adequate SIP. First, impaired focused attention may affect encoding relevant cues and, as a result, the interpretation of the problem situation. Indeed, to encode relevant information attention should be focused on the situation and irrelevant information should be filtered out. If not, the focus is on irrelevant information and inaccurate interpretations of the situation and others' intentions are likely to occur. Second, impaired inhibitory control may affect reflective problem-solving including the interpretation of the problem situation, the generation of multiple possible responses, the consideration of outcomes of responses, and the selection of the optimal response

among various responses available. For example, when maladaptive core beliefs cannot be inhibited hostile interpretations of the problem situation are made (Calvete & Orue, 2012). Inhibitory control is also required to generate multiple possible responses, instead of generating the most salient but inappropriate response, which is at the top of the memory bin because of its frequent activation and use. In addition, it is necessary to inhibit the urge to react and draw immediate conclusions; instead, different possible responses and outcomes of responses should be considered in view of selecting the optimal response. Third, impaired working memory may affect response generation, as working memory incorporates retrieved information from long-term memory (Baddeley, 1986), including various appropriate response options. In addition, impaired working memory may affect decision-making because of difficulties in keeping various possible responses and associated outcomes actively in mind (McQuade, Murray-Close, Shoulberg, & Hoza, 2013).

Some studies have explored the relation between EFs and SIP or similar concepts, but results remain inconclusive. A study by Van Nieuwenhuijzen, Orobio de Castro, Van Aken, and Matthys (2009) found low impulse control to be related to aggressive response generation in children and adolescents with low cognitive functioning. However, in this study, inhibition of impulses was measured by using behavior scales reported by care staff, and therefore a proxy of inhibition. SIP was measured by using videorecorded vignettes depicting social problems, but only one single SIP step was included. A study by Goldweber, Bradshaw, Goodman, Monahan, and Cooley-Strickland (2011) has focused on inhibition as well, but included more SIP steps. They provided evidence that children with average intelligence who have stable aggressive SIP, including hostile intent attribution, aggressive response generation, and justification of aggressive responses to threat, also have problems with behavior regulation. Again, inhibition was measured by using a behavior scale, reported by the child, and therefore a proxy of inhibition. A study by McQuade et al. (2013) used a more adequate measure of EF. They examined working memory in relation to a variety of social functioning measures among which conflict resolution skills. Results showed that impaired working memory was related to conflict resolution skills. Although working memory was measured using paper and pencil tasks testing the child itself, conflict resolution skills were measured by a three item scale reported by teachers, asking whether the child makes up a fight easily, gets over arguments quickly and talks about how to get over being mad at peers.

Recently, Wolfe, Vannatta, Nelin, and Yeates (2015) elaborated on previous research by examining both EFs and SIP in young children with low birth weight. EFs (inhibition, working memory, and set shifting) were measured by computerized tasks, and response generation, albeit one single SIP step, by using vignettes depicting social problems. EFs and response generation were positively correlated. In trying to examine the total SIP model and several EFs in children with mild to borderline intellectual disabilities, Van Nieuwenhuijzen and Vriens (2011) included all SIP steps and both inhibition and working memory. Results indicated inhibition to be related to interpretation, and working memory to encoding. Measures of EFs were paper and pencil tasks, however, and not computerized tasks.

Despite these first indications for the relation between SIP and EFs in different samples, more research is clearly needed. The main goal of the present study is to provide insight into the relation between EFs and SIP in adolescents with aggressive behavior, by including multiple EFs (inhibition, focused attention, and working memory) and multiple SIP steps (encoding, interpretation, response generation, evaluation, and selection), using appropriate measures. It will be examined whether multiple EFs are related to SIP variables. However, since EFs do not operate independently of each other (Miyake et al., 2000; Miyake & Friedman, 2012), multiple EFs will be examined in combination. Because of the hierarchical relation between EFs and SIP, we examined EFs as predictors of SIP. We hypothesized that, first, focused attention predicts encoding and interpretation; second, inhibition predicts interpretation, response generation, evaluation and selection; and third, working memory predicts response generation and selection.

Method

Participants

In the present study 94 adolescents aged 12 to 20 years participated (M = 15.88, SD = 1.44). Most of them (N = 86; 91.5%) were in the range of 14 to 18 years of age. Of the total sample, 46% were male, and 51% belonged to an ethnic minority. The mean IQ was 86 (SD = 12.02); 45% of the participants (n = 42) had an IQ in the range of 63 to 84, 39% (n = 37) in the range of 85 to 100, and 16% (n = 15) had an IQ of 100 or above. All participants were situated in Dutch secure residential care; 75% in secure youth care institutes (n = 71), 13% in juvenile justice institutes (n = 12), and 12 % in other residential facilities. Adolescents in these institutes are characterized by externalizing behavior problems, problematic parenting and family situations. In juvenile justice institutes, adolescents are convicted for their rule breaking behavior, but show similar behavior problems. Mean externalizing behavior problems were clinical according to professionals (see Table 1), with 39 participants (71%) scoring in the borderline to clinical range, but sub-clinical according to participants themselves (see Table 1), with still 46 participants (49%) scoring in the borderline and clinical range. According to professionals mean aggressive problems were in the normal range (see Table 1), with 16 participants (28%) scoring in borderline or clinical range, and rule-breaking problems were just under the borderline range, with 30 participants (55%) scoring in the borderline to clinical range. According to participants themselves both aggressive and rule-breaking problems were in the normal range (see Table 1), with 10% and 36% of the participants, respectively, scoring in the borderline to clinical range.

Table 1. *Descriptors*

	n	Mean	SD
Aggression YSR	94	56.21	7.60
Aggression CBCL	58	61.53	9.18
Rule-breaking YSR	94	63.24	8.73
Rule-breaking CBCL	55	66.07	7.22
Externalizing YSR	94	58.69	9.82
Externalizing CBCL	55	63.89	7.22
Focused attention Reaction time	94	46.18	60.65
Focused attention Errors	94	1.19	4.08
Inhibition False alarms	94	.46	.80
Inhibition Premature responses	94	.12	.52
Inhibition Reaction time	94	420.11	64.89
Working memory Correct trials	94	20.22	2.66
Working memory Targets in correct order	94	93.59	9.72

Measures

Behavior problems. For the assessment of behavior problems, professionals completed 32 items of the syndrome scales "Aggression" and "Rule breaking behavior" of the Dutch versions of the Child Behavior Checklist (CBCL; Verhulst, Van der Ende, & Koot, 1996; Achenbach, 1991a), and adolescents completed 32 items of the same scales of the Youth Self Report (YSR; Verhulst, Van der Ende, & Koot, 1997; Achenbach, 1991b). The YSR has been shown to be a valid and reliable self-report instrument in youth with MBID (Douma, Dekker, Verhulst, & Koot, 2006). Each item described a certain externalizing behavior, to which the adolescents had to answer on a three-point scale: 0 = not true, 1 = sometimes/somewhat true, or 2 = often/totally true. In nine cases some item scores were missing, which (with a maximum of three) were replaced by the individual's average score for the corresponding syndrome scale. Both syndrome scales were used to calculate the Externalizing behavior scale. By means of the Dutch norms for CBCL and YSR, *T*-scores were obtained for the Aggressive, Rule-breaking, and Externalizing scales. The standard CBCL and YSR calculation for the aggressive and rule-breaking scales describe that *T*-scores of 67 and higher are in the clinical range (98th percentile), and *T*-scores between 63and 67 are in the borderline range (93rd percentile). For the externalizing scale *T*-scores 63 and higher are in the clinical range (98th percentile), and *T*-scores between 60 and 63 are in the borderline range (93rd percentile).

Cognitive functioning. A full-scale IQ score (FIQ) was used from the respondent's clinical file in case an intelligence test had been administered in the year prior to our test administration. In the cases for which there was no recent FIQ, an estimation of global

intelligence was obtained using the subtests "Vocabulary" and "Block Design" from the Dutch version of the Wechsler Intelligence Scales, WISC-III[NL] in case participants were under 17 years of age (Kort et al., 2005) and the WAIS-III (Uterwijk, 2000) in case participants were 17 years or older. Estimates of the full-scale IQ were made based on the sum of the scaled scores on subtests "Vocabulary" and "Block Design", as they strongly correlate to the FIQ of WISC and WAIS (e.g., Hrabok, Brooks, Fay-McClymont, & Sherman, 2014). This estimation has been used successfully in youths with MBID as well (Van Nieuwenhuijzen & Vriens, 2012).

Executive functions. In order to measure the executive functions, subtests from the Amsterdam Neuropsychological Test battery (ANT; De Sonneville, 1999) were performed in all participants. Several studies have used the ANT successfully in clinical samples, including children with developmental disabilities (Swaab et al., 2000; Van Rijn et al., 2013). Validity and test-retest reliability have been demonstrated satisfactory (De Sonneville, 1999; Polderman et al., 2007). The participants received a full verbal and visual instruction, and practice session, before the administration of each subtest of the ANT.

Focused Attention. In order to measure focused attention skills the Flanker task of the ANT was performed by all participants. This computerized task measures the ability to focus attention on presented stimuli and block all other irrelevant incoming information. The Flanker task requires the integration of focused attention and cognitive flexibility, and has an average duration of four minutes. The participants viewed 80 subsequent trials: i.e., a square surrounded by eight equally-sized squares (the "flankers"). Compatible trials included nine squares of equal color (either blue or yellow), incompatible trials included a center square with a different color from the eight surrounding squares (also either blue or yellow). Participants were asked to press the right mouse key with their right index finger in case of a yellow center square, and the left mouse key with their left index finger in case of a blue center square. Responses were considered valid if participants reacted within 200-5000 ms of the onset of stimulus presentation. Focused attention was measured by the differences in mean reaction time (RT) and the differences in total amount of errors (pressing the wrong mouse key) between compatible and incompatible trials (Huijbregts, De Sonneville, Van Spronsen, Licht, & Sergeant, 2002). A high RT and a high amount of errors suggests problems with neglecting interfering flankers, and thus with focused attention.

Inhibition. For the measurement of inhibition skills, the subtest Go/No-go (GNG) of the ANT was performed. This computerized subtest measures the ability to inhibit behavior with 24 Go and 24 No-go stimuli, and has an average duration of four minutes. Participants viewed subsequent squares with or without a small opening in the outer line, presented for 800 ms on the screen in random order. The participants were asked to press the mouse key with their index finger of the preferred hand if they viewed a square with a small opening (Go), but to suppress this action in case of a solid square (No-go). Responses were considered valid if participants reacted within 200-2300 ms

of the onset of stimulus presentation. The required action in this subtest involved inhibition of behavior, and was measured with the total amount of false alarms (pressing the mouse key on a No-go stimulus), premature responses resembling the inability to withhold behavior during decision-making (pressing sooner than 200 ms after stimulus onset), and average RT for the hits (pressing after 200 ms after stimulus onset). A higher amount of false alarms and premature responses, and lower reaction time indicate problems with inhibition.

Working memory. For the measurement of working memory the subtest Visual Spatial Sequencing (VSS) of the ANT was performed. This task measures visuospatial memory, the temporal patterns in working memory, and has an average duration of 10 minutes. This computerized test presented a rectangle on the screen with nine circles. Twenty-four patterns of successive circles were designated by a "little hand" on the screen with a duration of 1000 ms per circle. Patterns increased in complexity and length. Participants were asked to remember these patterns, and to replicate them by clicking on the correct circles in the correct order. The total amount of correct trials (correct replication of the complete pattern of successive circles), and identified targets in correct order (correct circles in the correct order, also when half of a trial was correct) were used as indicators of adequate working memory.

Social information processing (SIP). In order to assess the SIP steps of Encoding, Interpretation, Response generation, Evaluation, and Response selection, scores were obtained by using the SIP test instrument – adolescent version (Van Rest et al., 2014, see Chapter 2). This instrument measures the SIP skills of the participants with a structured interview and six video fragments of hypothetical problematic social situations: four gender neutral, and four gender specific fragments, two for boys, two for girls. Participants received verbal instructions with every item of the SIP interview. Previous to each video fragment, the participants were asked to imagine that they were the victim in the specific situation.

Encoding was measured by asking "What do you think is the problem in this video fragment?". This question required the integration of information from the social situation. Responses were coded as: incorrect (0 points), semi-correct (1 point), or correct (2 points), and total mean scores were calculated across all six video fragments.

Interpretation was assessed by asking the participants: "X happened. Did Y (the perpetrator) do it on purpose?". The participants answered on a five-point Likert type scale, ranging from 1 (totally disagree) to 5 (totally agree). A total mean score for Hostile interpretation was obtained by calculating means across all six video fragments, with a higher score meaning more hostile interpretation.

Response generation was measured with the question: "If you had been the victim, what would you have done?" Answers were divided into three categories, along with the quality of each response: 1) assertive / pro-social, 2) aggressive / antisocial, and 3) submissive / passive. The total score for spontaneous Aggressive response generation was calculated by counting the number of aggressive responses across the six video

fragments. The score ranged from 0 (= this response was not given) to 6 (= this response was always given).

Evaluation of aggressive responses was measured by coding the participant's answers on the presented aggressive responses on the screen as possible enactments by the victim in the video fragments. The presentation of each response was followed by three items in order to assess the participant's response evaluation. For the current study, only positive evaluation was used. After the presentation of an aggressive response, the participants were asked: "Do you think it is good to act as the victim?". The participant could answer on a 5-point Likert type scale, ranging from 1 (totally disagree) to 5 (totally agree). A total mean score for Positive evaluation of aggressive responses was calculated across all six video fragments.

Selection was assessed by again presenting the three videorecorded responses, subsequently asking the participant: "Which of the three responses would you choose as the best reaction?" A total score for Aggressive response selection was calculated by counting the number of aggressive response selections across the six video fragments. The variable had a minimum score of 0 (= this response was never chosen) and a maximum of 6 (= this response was always chosen).

Procedure

Approval for the current study was attained from the scientific and ethical committee of the Faculty of Psychology and Education at the Vrije Universiteit Amsterdam. Adolescents were recruited through cooperation of several secure residential care institutes. Information on the study was presented for management and staff members of the secure residential care institutes. When institutes cooperated, all youth in the age of 12 to 20 were informed and asked to participate. After written informed consent was given, the assessment was planned. The adolescents were not selected on their (aggressive and antisocial) behavior, but on their placement in a secure residential setting. Furthermore, for anonymity reasons, no data were collected about the delinquent events or crimes of the adolescents. The data collection was carried out in the institutions by trained test assistants within a timeframe of two weeks. After assessment, youth were given a small present or monetary incentive for their cooperation.

Results

Overview of the Analyses.

First Pearson's correlations were conducted to examine univariate relations between variables. In addition, hierarchical linear multiple regression analyses were conducted, with age and IQ entered in the first step, the EFs variables that were significantly related to SIP at a univariate level were entered as predictors in the second step, and lastly, the individual SIP step was entered as outcome measure. An alpha level of .05 (two-tailed) was considered statistically significant.

Table 2. *Correlations between age, IQ, EF and SIP variables*

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Age	-												
2. IQ	-.11	-											
3. Encoding	-.11	.16	-										
4. Hostile interpretation	.11	.22*	.24*	-									
5. Aggressive resp.gen.	-.18	.15	.02	-.02	-								
6. Pos evaluation aggressive	.18	-.13	.13	-.06	.18	-							
7. Aggressive resp selection	.08	-.14	.04	-.03	.31**	.55***	-						
8. FA Reaction Time	-.14	.01	-.02	-.12	.01	-.20	-.18	-					
9. FA Errors	-.05	-.13	.03	-.04	.01	.17	.26*	-.20	-				
10. Inh False alarms	-.13	-.03	.03	-.04	.00	-.03	.04	.04	.09	-			
11. Inh Premature response	.07	-.10	-.04	-.10	.07	.28**	.38***	-.04	.11	.11	-		
12. Inh Reaction time	-.24*	.08	-.04	.19	-.01	-.33**	-.34**	.14	-.10	-.15	-.24*	-	
13. WM Correct trials	.25*	.21*	.06	.05	-.16	-.01	-.14	-.11	.04	.07	-.05	-.11	-
14. WM Correct order	.16	.24*	.02	.08	-.15	-.01	-.08	-.10	.03	.08	-.11	-.09	.81***

Note. * $p < .05$; ** $p < .01$; *** $p < .001$
Resp. = Response, Gen. = Generation, Pos = Positive
FA = Focused Attention; Inh = Inhibition; WM = Working Memory

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Relations Between EFs and SIP

First, correlations between EFs and SIP variables were examined (see Table 2). Because the two working memory variables correlated rather highly, only the variable "correct trials" was included in the further analyses. Because age positively related to working memory (correct trials) and inhibition (reaction time), and IQ to working memory (correct trials), both age and IQ were controlled for in the analyses. Univariate relations were found between focused attention, inhibition, and evaluation and selection of aggressive responses (see Table 2); these variables were entered in the models tested.

When examining multivariate relations, a model of age, IQ, and inhibition variables predicted positive evaluation of aggressive responses. After controlling for age and IQ, premature responses and low reaction time on inhibition tasks in particular were unique significant contributors (see Table 3).

In addition, a combination of age, IQ, focused attention, and inhibition predicted aggressive response selection. After controlling for age and IQ, youths who had problems with focused attention (more errors), and inhibition (more premature responses and low reaction time) were more likely to select an aggressive response (see Table 3).

Table 3. *Predictors (EFs) and outcome variables (SIP)*

Outcome		Predictors	F(Change)	R^2	p	β	p
Positive evaluation of aggressive responses	Model 1	Age, IQ	2.41	.05	.10		
	Model 2		6.18	.12	.003		
		Age				.12	.25
		IQ				-.08	.43
		Inhibition Premature responses				.21	.05
		Inhibition Reaction time				-.27	.02
Aggressive response selection	Model 1	Age, IQ	.57	.01	.57		
	Model 2		8.94	.25	.000		
		Age				-.02	.85
		IQ				-.03	.74
		Focused Attention Errors				.20	.04
		Inhibition Premature responses				.29	.004
		Inhibition Reaction time				-.25	.01

Discussion

The present study aimed to examine the relation between multiple EFs (focused attention, inhibition, and working memory) and multiple SIP steps (encoding, interpretation, response generation, evaluation, and selection) in adolescents with aggressive behavior. The results indicate first that positive evaluation of aggressive responses is predicted by inhibition, and second that the selection of aggressive responses is predicted by problems in both inhibition and focused attention, even after controlling for age and IQ. These results align line with previous studies (e.g., Goldweber et al., 2011; Van Nieuwenhuijzen et al., 2009: Wolfe et al., 2015), as some relations were found significant, but others were not. The present study shows no relations between EFS and the early information processing steps (encoding, interpretation, and response generation), but does with the later information steps (evaluation and selection, i.e., those involving decision-making).

When focusing on the content of the relations, evaluation of aggressive responses was, as expected, predicted by impaired inhibition. To consider different possible responses and outcomes of responses, one needs to inhibit the urge to react and draw immediate conclusions. In addition, selection of an aggressive response was predicted by both focused attention and inhibition. Unexpectedly, focused attention was related to selection as well. Apparently, focused attention is needed to evaluate outcomes of different response options and to select a matching response. From a theoretical point of view, focused attention was not expected to be related to the last step of decision-making (selection). In the SIP task used, however, a lot of information is presented (three response options) before the respondent is asked to decide upon the best response, and for this purpose both controlling of attention (focused attention) and responses (inhibitory control) seem to be needed. In everyday social functioning, adequate cognitive control is probably a precondition for appropriate decision-making. In the present study, the combination of impaired focused attention and inhibitory control predicted aggressive response selection in adolescents with behavior problems. This is in line with the conceptualization of executive functioning as a construct with related but distinguished components (Miyake et al., 2000; Miyake & Friedman, 2012). The study findings thus support the need to consider the different components of EFs as higher-order cognitive abilities that operate together in affecting other cognitive functions such as SIP.

Unexpectedly, no relation of any sort was found with the SIP step encoding. This may be due to the measurement of encoding; respondents were asked whether they could recognize the problem, which is not merely encoding information but also interpretation of the situation. Encoding is hard to disentangle from interpretation using the videorecorded vignettes method (Van Rest et al., 2014, see Chapter 2). Other measures, such as eye tracking, in which eye movements are followed that highlight which cues are encoded (Horsley, Orobio de Castro, & Van der Schoot, 2010), come closer to encoding and thus may show different results. Likewise, no relations were found with hostile interpretation and response generation, whereas previous studies found unique relations between EFs and both interpretation and response generation (Goldweber et al., 2011; Van Nieuwenhuijzen et al., 2009; Van Nieuwenhuijzen & Vriens, 2012; Wolfe et al., 2015). These results can be explained by differences in EFs measures: EFs tasks in the present study are direct motor impulsivity tasks, whereas in previous studies reports of impulsive behaviors are used.

When interpreting the results, some limitations need to be considered. First, looking into the self-reported behavioral measures it was found that aggression and rule breaking behavior scores were in the subclinical range of behavior, whereas reports by professionals were in the clinical range. Although behavior problems may seem absent, self-reported ratings of behavior are obviously lower than when reported by proxy, and adolescents were placed in a secure residential setting due to their externalizing behavior problems and/or delinquent acts.

Second, unfortunately no other clinical information about the sample was available to confirm the severity of the aggressive problems, such as length of stay. In addition, no information on internalizing behavior problems, attention, hyperactivity, and impulsivity problems was available, whereas comorbidity of internalizing, attention, hyperactivity, impulsivity, and externalizing behavior problems in adolescents in residential care is high (Ståhlberg, Anckarsäter, & Nilsson, 2010). This allowed us to only test a biased model with externalizing behavior problems, and not study the possible specific role of comorbidity in the relation between EFs and SIP. Future research should examine whether the associated internalizing, attention, and impulsivity problems play a role in the effect of EFs on SIP.

Third, it should be noted that the visuospatial sequencing task (VSS) mainly assesses the ability to retain information, one component of working memory which is also referred to as short-term memory. The VSS only partially assesses the process of the central executive, a control and manipulation system that selects the strategies and controls the processes involved in short-term storage. Visuospatial memory, however, is considered to be more dependent on the central executive than verbal short term memory (Hambrick, Kane, & Engle, 2005). In order to measure working memory validly, a manipulation task should be included, such as the ability to remember certain sequences in reversed order. In addition, both visual versus verbal working memory need to be considered when addressing working memory.

In conclusion, the results of the present study showed that the decision-making part of SIP in adolescents with severe behavior problems is affected by impaired focused attention and impaired inhibitory control. Results suggest that different components of EFs as higher-order cognitive abilities operate together in affecting other cognitive functions such as SIP.